



Agricultural Genome to  
Phenome Initiative

## The View from the United States on Developing for Resources for Agricultural Genomics and Phenomics

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## USDA-NIFA Agricultural Genome to Phenome Initiative

- 2018 Farm Bill directed NIFA to establish a new competitive grant program to support research concerning genomes and phenomes of crops and animals of importance to US agriculture, authorizing up to **\$40,000,000 annually 2019 - 2023**.
  - <https://nifa.usda.gov/program/genome-phenome-initiative>
- U.S. Congress appropriated only **\$1M in fiscal year 2020**  
**\$1M in fiscal year 2021**  
**\$2M in fiscal year 2022**

**2020 RFA:** “NIFA’s AG2PI focuses on collaborative science engagement and invites innovative research proposals that intend to  
**develop a community of researchers across crops and animals**  
that will **lay the foundation for expanding knowledge concerning**  
**genomes and phenomes of crops and animals** of importance to US agriculture.”

# Creating a Shared Vision Across Crop & Livestock Communities



## Overall objective:

Assemble a transdisciplinary community and prepare it for an anticipated large-scale R&D effort in AG2P

### Project Team

#### Executive Board Members



Dr. Patrick Schnable  
Iowa State University



Principal Investigator



Dr. Jennifer Clarke  
University of Nebraska-Lincoln



Dr. Jack Dekkers  
Iowa State University



Dr. David Ertl  
Iowa Corn Promotion Board



Dr. Carolyn Lawrence-Dill  
Iowa State University



Dr. Eric Lyons  
University of Arizona



Dr. Brenda Murdoch  
University of Idaho



Dr. Chris Tuggle  
Iowa State University



**AG2PI aims to connect  
crop and livestock scientists to each other  
and to scientists working in  
data sciences, statistics, engineering and  
social sciences  
to identify shared problems  
and collaborate on solutions  
in agricultural genome to phenome  
science**

## What's Required to Realize this Vision?

- A **community** of interactive biologists (crop + livestock), engineers, data scientists and members of the greater community
- More **data** (phenotypes, genotypes and environment/management practices) ideally from coordinated, multi-disciplinary, multi-location, multi-year projects

Genotype (G) + Environment (E) + G x E = Phenotype (P)

- New **technologies** and analysis methods
- Substantial new **R&D investments**



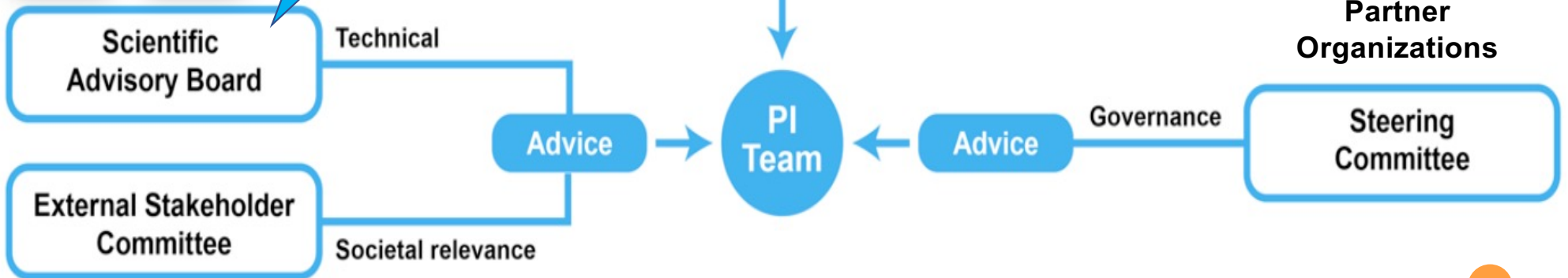
# Organizational Structure 2020-2023



Noelle Cockett  
Archie Clutter  
Henner Simianer  
Mike Goddard...

**Executive Board Members**

 Dr. Patrick Schnable Iowa State University	 Dr. Jennifer Clarke University of Nebraska-Lincoln	 Dr. Jack Dekkers Iowa State University	 Dr. David Ertl Iowa Corn Promotion Board
 Dr. Carolyn Lawrence-Dill Iowa State University	 Dr. Eric Lyons University of Arizona	 Dr. Brenda Murdoch University of Idaho	 Dr. Chris Tuggle Iowa State University



# External Stakeholder Member Organizations



Agricultural Genome to Phenome Initiative



## Role of Stakeholder Organizations

- Link communication between AG2PI, organization employees and members, including sharing AG2PI news and events
- Participate in AG2PI activities, including contributing materials or expertise
- Provide feedback through surveys and one-on-one communication with AG2PI executive board members



















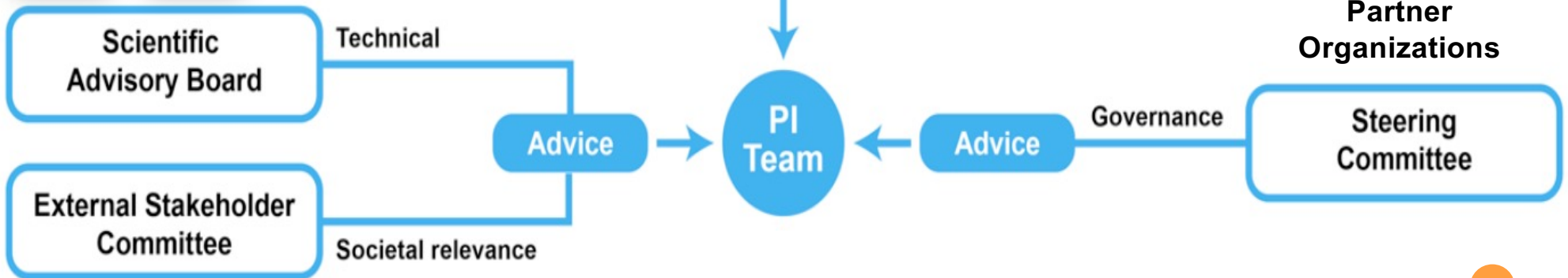
Poultry Breeders of America

# Organizational Structure 2020-2023



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 Dr. Carolyn Lawrence-Dill Iowa State University 	 Dr. Eric Lyons University of Arizona 	 Dr. Brenda Murdoch University of Idaho 	 Dr. Chris Tuggle Iowa State University 



# Partner Organizations



## Role of Partner Organizations

- Provide feedback to AG2PI executive board regarding project activities & next steps
- Link communication between AG2PI, organization employees and members, including sharing AG2PI news and events
- Participate in AG2PI activities and surveys, including contributing materials or expertise



**National Animal  
Genome Research  
Program  
NRSP-8**



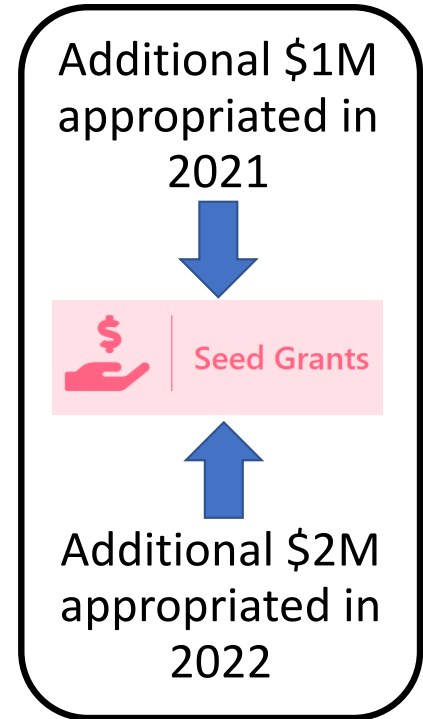
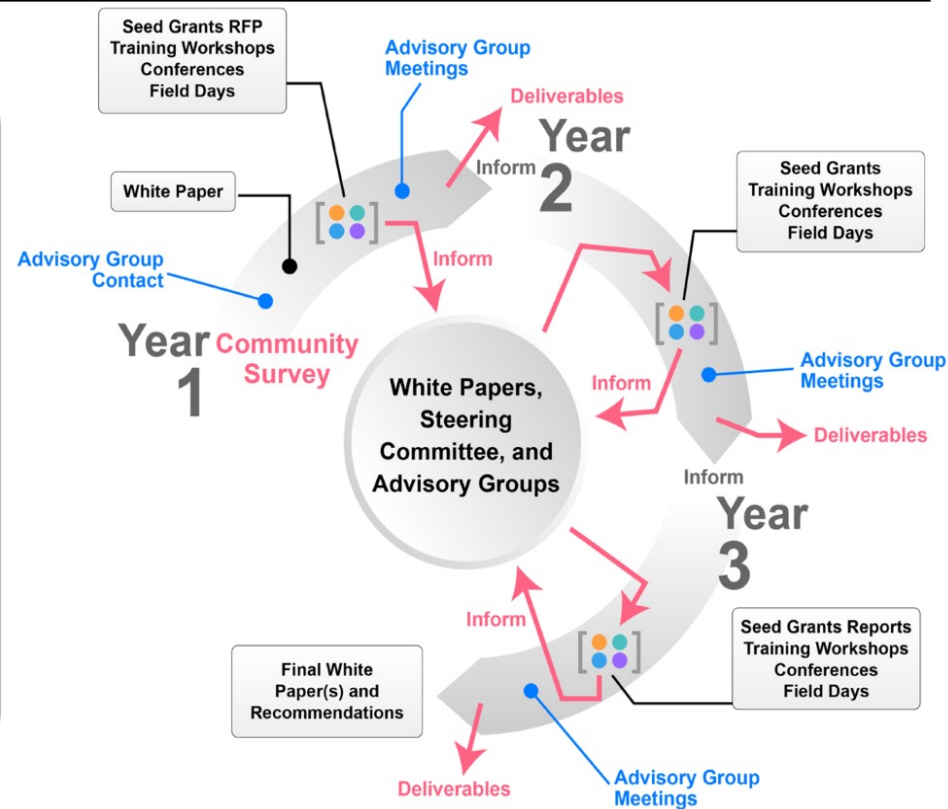
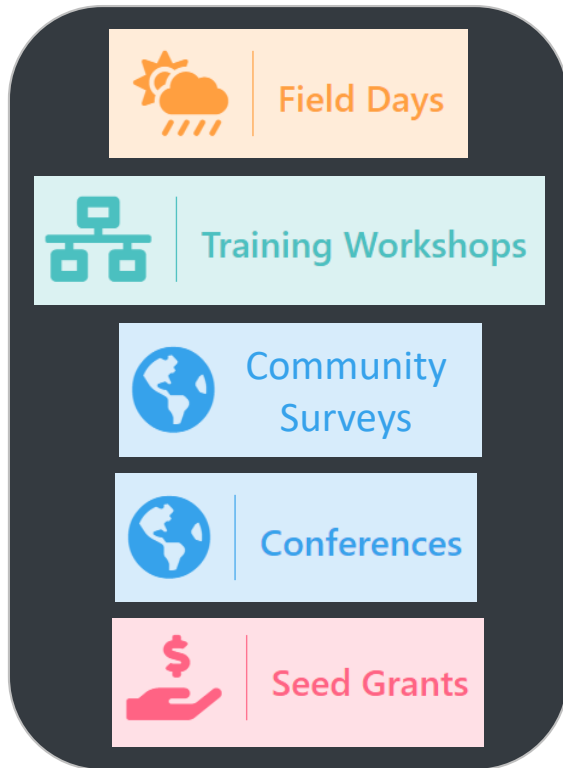
**AgBioData**

Toward enhanced genomics, genetics, and breeding research outcomes through standardization of practices and protocols across agricultural databases





# Activities & Deliverables 2020 grant (\$1M)





## Goals

- Expose Ag G2P community to research activities and resources across crops and livestock
- Share research methods, approaches, capacities
- Identify research and capacity gaps and challenges for AG2P research
- Provide a platform for introducing teams that can develop joint solutions

## Selection of Past Field Day Topics:

- Automating Phenotyping
- Genomic Selection and Phenotyping in Dairy Cattle
- U.S. Aquaculture
- Precision Livestock Management
- Breeding Challenges in Fruit Trees
- AI and Agriculture
- IP in Livestock and Crop Breeding and Genetics
- Quantitative Multi-omics to Unravel G2P in Crops and Livestock
- International Centers & Partnerships: Genetic Improvement Resources and Opportunities
- Incorporating Domain Knowledge in Genetic/Genomic Prediction & Analysis Models
- Leveraging Microbiomes in Agriculture



## Goals

- Build technical strengths and future collaborative AG2P communities
- Offer a suite of workshops to enable researchers from all backgrounds and computational skill levels to develop best practices, common vocabularies, and technical expertise around genomic and phenomic cyberinfrastructure, data tools and pipelines, statistics, and experimental techniques

## Selection of Past Workshop Topics:

- Foundations of Computation: Introduction for Biologists
- Introduction to Scientific Computing
- Unix and Git Skills
- Genotype to Phenotype for Non-Biologists
- Introduction to SNP Data Analysis
- A Guide to GWAS
- Hands-On Machine Learning with Agricultural Applications
- Structural Variant Detection in Animal Populations
- Developing Mobile Computer Vision Applications for Improved Recognition of Livestock
- The APSIM Software Platform to Predict and Explain Genotype x Management x Environment Interactions
- Intermediate Omics Data-Enabled Genomic Prediction and Mediation Analysis



## Goals

- Collect community opinions on topics related to AG2P
- Collect information to better understand current resources and gaps relative to AG2P research
- Provide content for conferences



## 2020 Survey Purpose:

- Define the genome to phenome community
- Seek community perspectives on the needs for accelerating AG2P research
- Collect ideas about which specific activities would meet those needs

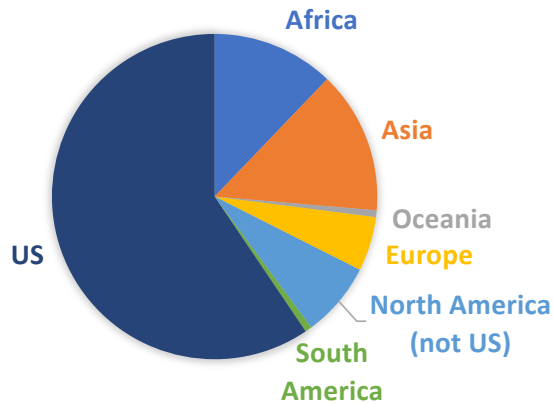
## 2021 Survey Purpose:

- Identify access and barriers to resources in G2P research, training and other efforts

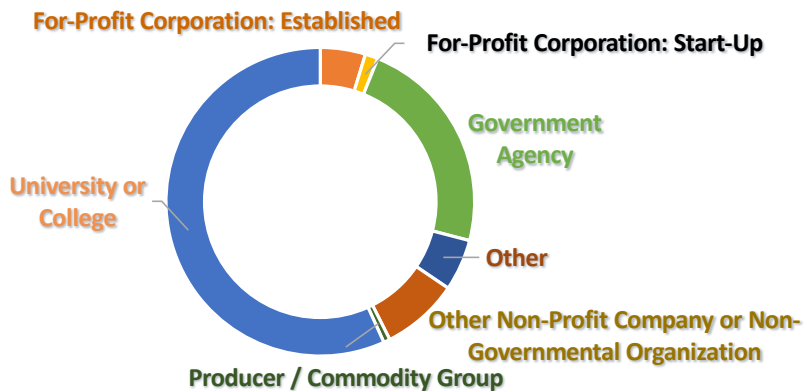
Preprint available on OSF: <https://osf.io/p89vk/>



### 2022 AG2PI SURVEY RESPONDENTS, BY LOCATION



### 2022 AG2PI SURVEY RESPONDENTS, BY EMPLOYER TYPE



15-question survey

\* These topics came from AG2PI Scientific Advisory Board and Steering Committee

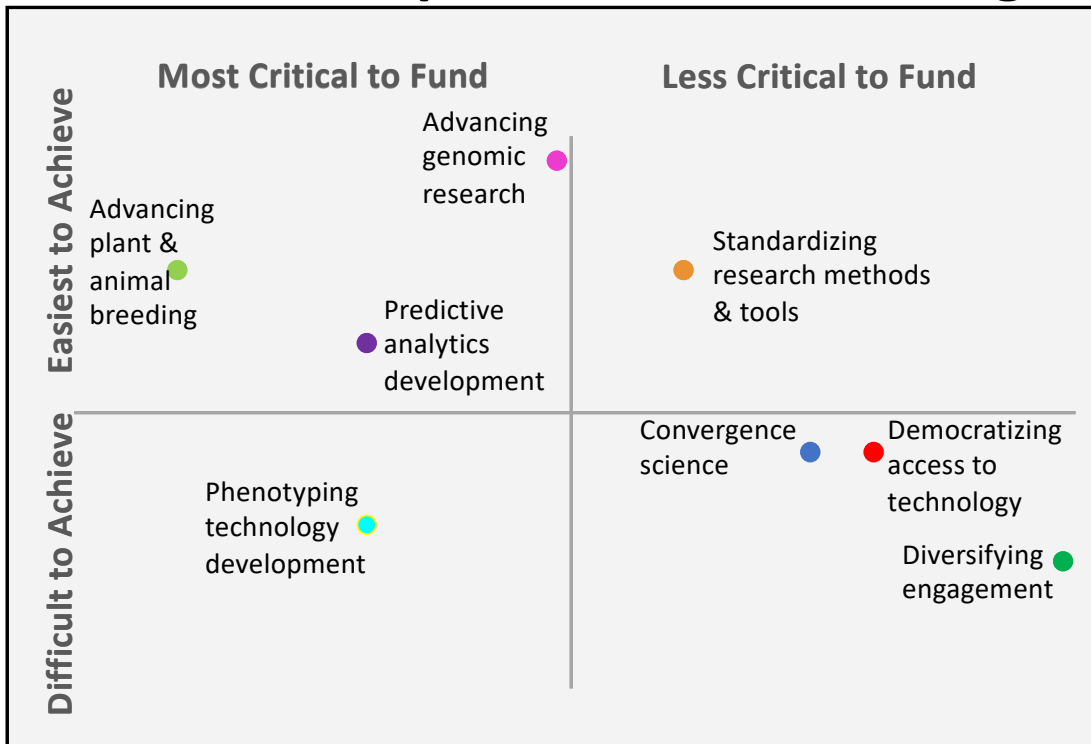
Deployed in June of 2022

**Purpose:** to narrow the scope of future funding to areas that are **most critical** to advancing G2P research as well as those that are **easiest to achieve**

Participants were asked to rank the topics by both criteria above



## Identified topics and their ranking



### Challenges that overlap topics:

- Shortage of trained personnel
- Disrupting cultural norms in scientific disciplines and industry practices
- Communicating failures to avoid duplicating practices destined to fail
- Gaining public trust or support for new technologies or products
- Continuing to discover new phenotypes, which are currently unknown and untargeted
- Addressing cost-effectiveness
- Navigating intellectual property ownership



## Goals

- Bring people together to develop a vision for the future of Ag G2P and build community
- Identify opportunities and resources within the crop and livestock communities
- Support discussions across research and stakeholder communities
- Communicate and disseminate findings
- Develop white papers to inform USDA NIFA towards future AG2P research and development

## Past Conferences:

- Seed Grant mini-conferences
- Listening Sessions at national meetings
- Sept. 22 Conference/Workshop:  
“Thinking Big: Visualizing the Future of AG2PI”



White Paper



Agricultural Genome to  
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White paper draft based on Sept 2022 Workshop sent to NIFA:  
“Current Challenges and the Future of Agricultural Genomes to  
Phenomes in the U.S.”

We recommend that AG2PI funding be used to address the following critical milestones:

1. Provide resources to evaluate and **improve Ag G2P predictive tools**, including generation of *benchmark testing datasets*.
2. **Remove current public-private barriers** for collaborating with commercial entities that maintain *large phenotypic datasets*.
3. Establish a **single comprehensive public genome/phenome knowledge base** that enables FAIR data sharing as a foundation for *building on Federal investments* in agricultural genomes.
4. Accelerate the **training of scientists required for agricultural G2P research**, including toward developing and evaluating *data analytics training programs*.
5. Expand the **diversity of people engaged in agricultural G2P activities**, including *researchers, students and producers*.
6. **Identify additional gaps** in knowledge, multidisciplinary team development, education/training, and analytical or quantitative methods relevant to agricultural G2P and *initiate actions to fill those gaps*.

[Send your thoughts and suggestions to AG2PI!](#)





# AG2PI Conference: 2023 (In Person)



## Goal

- Community directing the future of R&D in AG2P

## Details

- When:
  - June 15-16 2023 in Kansas City, MO
- Who:
  - Stakeholder Organization reps
  - Scientific Advisory Board
  - Partner Organization leaders
  - All seed grant awardees
  - Registrants from outside AG2PI boards
- What:
  - Panels followed by small group breakouts



# AG2PI Conference: 2023 (In Person)



## High Level View of Discussion Outcomes

- The next round of genome to phenome (G2P) **funding needs to support the people in research fields** in addition to supporting research itself. This should include:
  - additional larger-scale grants to allow for multi-year planning and staffing
  - more funding for staff positions, graduate students/fellowships, and career development/skills training
  - investing in a multi-disciplinary career pipeline for students
- The next round should also focus on **removing bottlenecks in research fields by investing in capacity, collaboration, and infrastructure**. This should include:
  - capital support for research infrastructure, especially around data collection, analysis, and reporting
  - prioritizing collaborative research projects (interdisciplinary, cross-sector, and public-private)
  - communicating the impact of G2P research publicly and raising knowledge among consumers about food systems



# 2023 In-Person Conference: "What one thing..."

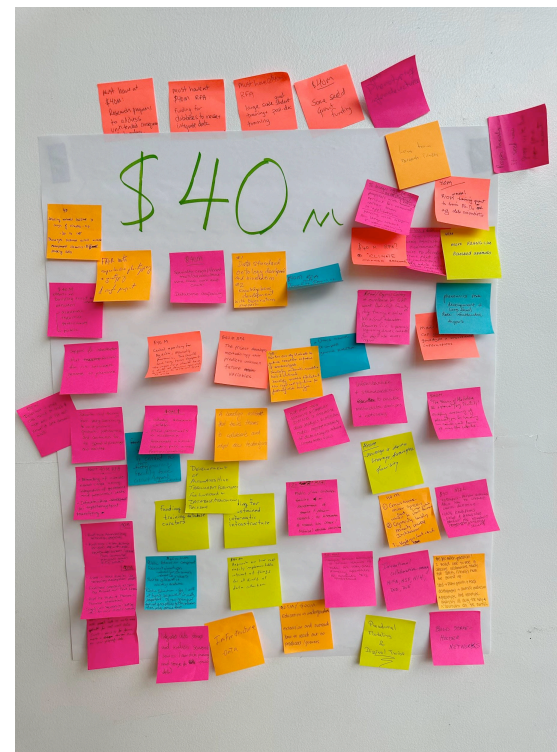
## \$2.5M RFA Priorities

Data Infrastructure	19
Investing in people	8
Phenotyping infrastructure	8
Early/Risky funding	6
Stakeholder involvement	4
Better/More Collaboration	4
Systems change	3
Engaging w/ public	2
Miscellany	5



## \$40M RFA Priorities

Data Infrastructure	22
Capacity building / training / education	10
Better/More Collaboration	8
Engaging w/ public	7
Tech development	7
Funding	4
Climate-related	4
Beyond major spp	4
Miscellany	5
Unknown unknowns	2



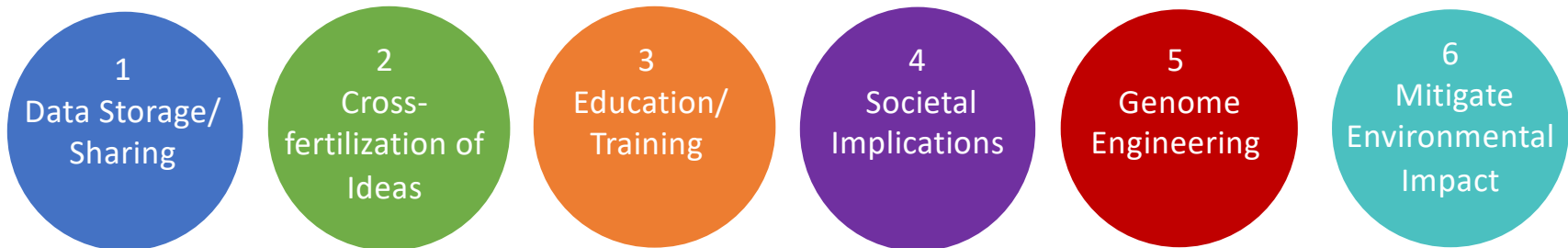


Seed Grants

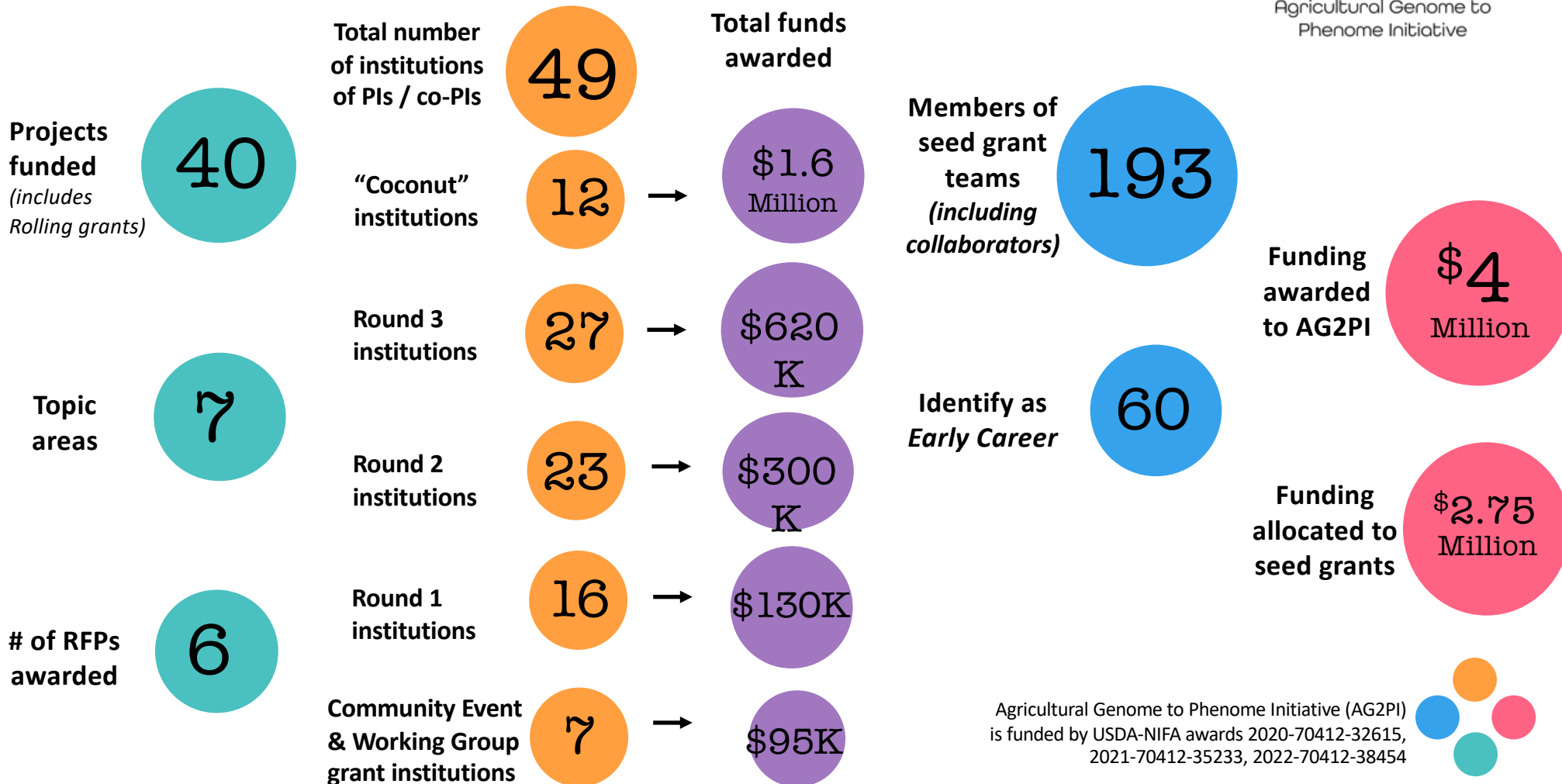
## Goals

- Promote collaboration and support the development and cross-pollination of tools, data, and ideas to enable and facilitate future AG2P research
- Foster first steps towards the development of community solutions
  - Research needs and opportunities, physical infrastructure needs, promote capabilities in data processing, analysis and management

## Focus areas funded



# Seed Grants Overview – By the Numbers



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# How Can YOU participate in AG2P? Help develop global vision and solutions

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**Develop a Vision → should come from the community (us)**

- Identify the research and/ or physical infrastructure needs and opportunities

**Develop Community Solutions → can be a global solution!**

- Identify the key resources (tools, people, sensors, etc.) necessary for success
- Identify a list of priorities and potential path(s) forward



## Genome to Phenome Priority Areas

### What resources are important to further AG2P related research?

Some examples might include:

- Tools and technology – genetic, phenotypic (sensors- environmental, internal), computation (algorithm), data processing, storage or analyst
- Collaborators – computational or data analyst, engineer, complementary field in animal science interested in phenotype (nutritionist, physiologist, meat sci/muscle bio)?
- Strategies to mitigate environmental impact
- Genome engineering
- Education and training



## Further ideas on global participation in AG2PI

- What is important to animal agriculture G2P research?
- What do our respective stakeholders need to make genetic progress in a changing environment?
- How can we work with others to expand what we can deliver?
- How can we help inform NIFA as they establish a new competitive grant program to support research the area of AG2P importance to US agriculture?
- U.S. Congress appropriated ***\$2,500,000 in fiscal year 2023*** for AG2PI, expect this to continue in future years....





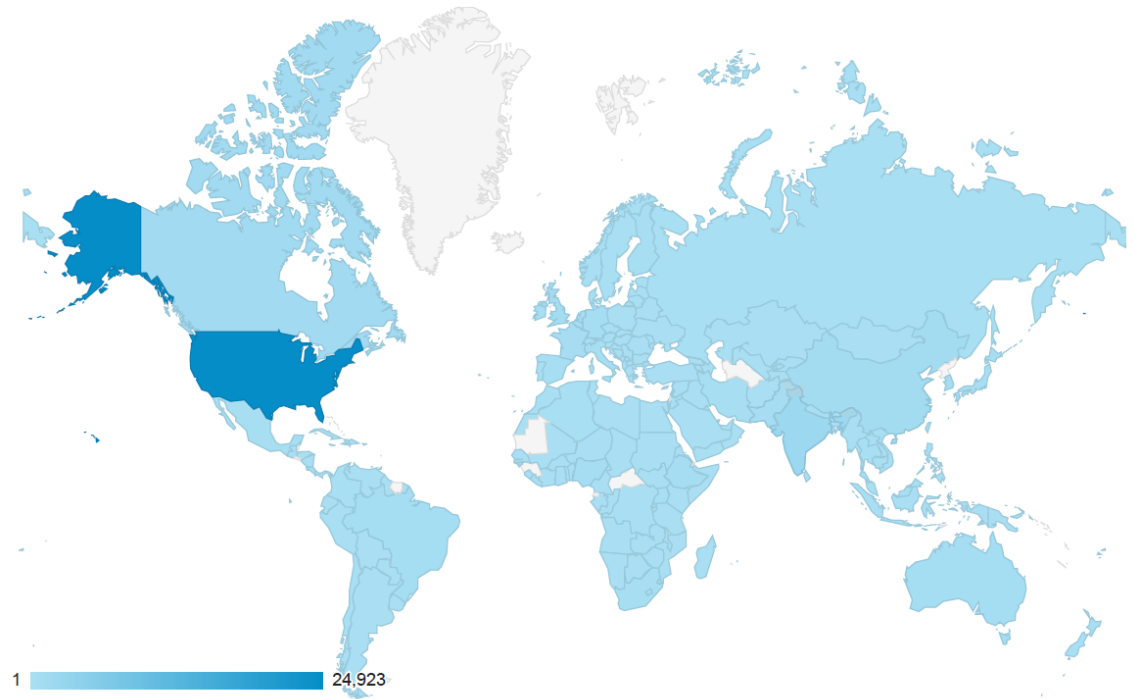
## Reaching the AG2PI Community

**REACH US AT:**

<https://www.ag2pi.org>



@AG2PI



Visitors to AG2PI website October 1, 2020 – July 12, 2023  
(over 43,000 unique visitors from 171 countries)

# AG2PI

Agricultural Genome to  
Phenome Initiative

# Thank you!



<https://www.ag2pi.org>



## Executive Board Members



Dr. Patrick Schnable  
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Principal Investigator



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Nick Dekkers  
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Dr. Carolyn Lawrence-Dill  
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